In The United States Patent And Trademark Office

In Re Application: Tianqing He et al.

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Serial No: 10/714,471 Art Unit: 3749

Invention: Device And Method For Rapid Drying Of Porous Materials

AFFIDAVIT

NOW COMES the undersigned, who affirms and says:

1. My name is Ali Regimand. I am the president of InstroTek, Inc. and a co-inventor for the Device and Method for Rapid Drying of Porous Materials filed in the United States Patent Office with Serial #10/714,471.

2. The Vacuum Drying Apparatus and Method disclosed and claimed in serial #10/714,471 has been successfully manufactured and marketed as the "CoreDry' by InstroTek, Inc., the company which I am President. The CoreDry is priced at $4910 per unit and since its marketing launch in 2004, my company has sold a total of 120 units. The volume for this product is expected to quadruple in the next 3 years because of the newly developed ASTM standard, described below, and Department of Transportation Specifications currently being developed in many of the states.

3. CoreDry does not have a price advantage over other vacuum dryer models on the market because the CoreDry, to my knowledge, is the only vacuum dryer for porous materials like asphalt currently being sold. The CoreDry has been successful in the market because it represents an advance in the art and has provided the users a fast and more accurate method of testing asphalt samples.

4. Attached as Exhibit A is the newly developed American Society for Testing and Materials (ASTM) standard practice, specifically developed for the CoreDry. To my knowledge, there are no other ASTM specifications for other Vacuum Drying Apparatus, since there are no other vacuum devices or processes available for asphalt drying.

ASTM International is one of the largest voluntary standards development organizations in the world for development of technical standards for materials, products, systems, and services. Standards developed at ASTM are the work of over 30,000 ASTM members. These technical experts represent producers, users, consumers, government and academia from over 100 countries.

ASTM standards are accepted worldwide by public and private agencies. In fact, some agencies will not allow the use of an equipment, process or material without an ASTM specification.

Due to the newly developed ASTM standard, CoreDry is now a process that is internationally recognized in the asphalt testing field. This standard further validates CoreDry as a new and useful process for accurate and fast drying of porous asphalt samples.

5. Attached as Exhibit B are procedures established in Colorado, Pennsylvania and a test report from Colorado regarding the CoreDry. We also know that Florida and Alabama are currently developing specifications for the CoreDry, with others states following close behind. These documents and specifications further independently validate the CoreDry technology and the advance in the art represented by the CoreDry technology and patent application, serial #10/714,471.

THE AFFIANT, first being warned that willful false statement and the like are punishable by fine, imprisonment, or both under Title 28 U.S.C. 1001, states that the above information is true except those things stated on information and belief and as to those things the undersigned believes them to be true.

This the 13th day of September, 2006

Al Regimand, President
InstroTek, Inc.

Colorado Procedure 44-07

Standard Method of Test for

Bulk Specific Gravity and Percent Relative Compaction of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

This procedure modifies AASHTO T 166-93. AASHTO T 166-93 or any subsequent revisions may not be used in-place of this procedure.

1. SCOPE

1.1 These test methods cover the determination of bulk specific gravity of specimens of compacted bituminous mixtures as defined in ASTM E 1547, Terminology Relating to Industrial Chemicals.

1.2 The bulk specific gravity of the compacted bituminous mixtures may be used in calculating the unit weight of the mixture.

2. REFERENCED DOCUMENTS

2.1 *ASTM Standards:*

D 2726 Test Method for Bulk Specific Gravity and Density of Compacted Bituminous Mixtures Using Saturated Surface-Dry Specimens

E 1547 Terminology Relating to Industrial Chemicals

2.2 *Colorado Procedures:*

CP-L 5115 Preparing and Determining the Density of Bituminous Mixture Test Specimens Compacted by the Superpave Gyratory Compactor

3. SIGNIFICANCE AND USE

3.1 This procedure covers and describes two test methods for determining bulk specific gravity in order to calculate the percent relative compaction of Hot Mix Asphalt.

4. TERMINOLOGY

4.1 Definitions:

4.1.1 *Constant Mass* – The mass at which further drying at either temperature as noted in Section 10.4 for two hours does not alter the mass by more than 0.05 percent.

5. TEST SPECIMENS

5.1 Test specimens may be either laboratory-molded bituminous mixtures or from the bituminous pavements. The mixtures may be surface or wearing course, binder or leveling course, or hot mix base.

5.2 Size of Specimens--It is recommended, (1) that the diameter of cylindrically molded or cored specimens, or the length of the sides of sawed specimens, be at least equal to four times the maximum size of the aggregate; and (2) that the thickness of specimens be at least one-and-one-half times the maximum size of the aggregate.

5.3 Pavement specimens shall be taken from pavements with a core drill, a diamond or Carborundum saw, or by other suitable means.

5.4 Care shall be taken to avoid distortion, bending, or cracking of specimens during and after the removal from pavement or mold. Specimens shall be stored in a safe, cool place.

5.5 Specimens shall be free from foreign materials such as seal coat, tack coat, foundation material, soil, paper, or foil.

5.6 If desired, specimens may be separated from other pavement layers by sawing or other suitable means.

6. APPARATUS

6.1 *Balance* – Conforming to the requirements of AASHTO M 231, for the class of balance required for the principle sample weight of the sample being tested. The balance shall be equipped with suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of scale pan or balance.

6.2 *Suspension Apparatus* -- Wire suspending the container shall be the smallest practical size at the point where it penetrates the water's surface to minimize any possible effects of a variable immersed length. The suspension apparatus shall be constructed to enable the container to be immersed to a depth sufficient to cover it and the test sample during weighing without contacting the bottom of the water bath.

6.3 *Water Bath* -- For immersing the specimen in water while suspended under the balance, equipped with an overflow outlet for maintaining a constant water level.

6.4 *Damp Towel* -- Flannel or terry cloth towel.

6.5 *Oven* – If using Method B (Rapid Test), a forced draft oven capable of maintaining 230°F ± 9° (110°C ± 5°).

6.6 *CoreDry™* – If using Method C (CoreDry™ Test), a CoreDry unit from Instrotek® Inc.

METHOD A

7. PROCEDURE

7.1 Method A shall be used for laboratory compacted specimens only.

7.2 Laboratory compacted specimens, which have not been exposed to moisture, do not require additional drying. Cool the specimen to room temperature at 77°F ± 9° (25°C ± 5°). Samples must not feel warm to the touch. Record the dry mass A. If laboratory compacted specimens are wetted before the dry mass is determined, dry them as specified in Section 10.4 once the immersed mass and surface-dry mass have been determined. Immerse each specimen in water at 77°F ± 1.8° (25°C ± 1°) for 4 ± 1 minutes and record the immersed mass, C. Remove the specimen from the water, damp dry the specimen by blotting it as quickly as possible with a flannel cloth or terry cloth towel which has been thoroughly wetted and wrung out, then immediately determine the surface-dry mass, B. The objective of blotting is to remove all of the surface water without losing any water that has been absorbed into the sample. Any water that seeps from the specimen during the weighing operation is considered part of the saturated specimen.

NOTE 1: If desired, the sequence of testing operations may be changed to expedite the test results. For example, first the immersed mass (C) can be taken, then the surface-dry mass (B) and finally the dry mass (A).

8. CALCULATIONS

8.1 Calculate the bulk specific gravity of the specimens as follows (round and report the value to the nearest three decimal places):

$$\textbf{Bulk Specific Gravity} = \frac{A}{(B - C)}$$

Where:

A = Mass (in grams) of sample in air,
B = Mass (in grams) of surface-dry specimen in air,
C = Mass (in grams) of sample in water.

8.2 Calculate the percent water absorbed by

the specimen (on volume basis) as follows:

$$\text{Percent Water Absorbed by Volume} = \frac{(B - A)}{(B - C)} \times 100$$

9. RECORD

9.1 No CDOT Form, record on your own worksheet.

METHOD B (RAPID TEST)

10. PROCEDURE

10.1 Method B shall be used for pavement cores.

10.2 This procedure can be used for testing specimens, which are not required to be saved, and which contain substantial amounts of moisture. Specimens obtained by coring or sawing can be tested the same day by this method. Specimens obtained by coring or sawing shall be tested using Method B or C and shall not be tested using Method A.

10.3 The testing procedure to determine the immersed mass (C) and the surface dry mass (B) shall be the same as given in Section 7. The dry mass (A) of the specimen is determined last, as per 10.4.

10.4 Determine and record the weight of a large flat bottom drying pan and place the weighed specimen into the pan. For Forced Draft Ovens, place the pan and specimen in a 230°F ± 9° (110°C ± 5°) oven. For 5½ in. (140 mm) diameter or larger cores, or for porous or wet cores, leave the specimen in the oven until it can be easily separated into pieces not larger than 2 in. (50 mm) in diameter. Use extreme caution not to lose any portion of the original specimen while separating it. Replace the separated specimen in the oven. Document the start time. Dry all of the specimen(s) for 3 hours minimum and determine the weight at that time, (record the time). After an additional 2 hours of drying determine the weight at the time, (record the time if needed). The drying of the specimen can be stopped at this minimum of 5 total hours if constant mass is reached. Continue the drying and weighing at 2-hour intervals until constant mass is reached, up to the 24-hour maximum period. Determine the final weight of the heated specimens and use this weight as the dry mass A in the equation in Section 8.1.

METHOD C (COREDRY™ TEST)

11. PROCEDURE

11.1 Method C may be used for pavement cores in place of Method B.

11.2 This procedure can be used for testing specimens, which can be saved, and which contain substantial amounts of moisture. Specimens obtained by coring or sawing can be tested the same day by this method. Specimens obtained by coring or sawing shall be tested using Method B or C and shall not be tested using Method A.

11.3 The testing procedure to determine the immersed mass (C) and the surface dry mass (B) shall be the same as given in Section 7. The dry mass (A) of the specimen is determined last, as per 11.4.

11.4 Turn CoreDry™ to ON position. Allow the CoreDry™ to warm up and go through preparation cycles until the "System Ready" prompt appears. Allow cores to warm to room temperature and towel dry the surface of cores if there is free standing moisture on the surface. Place core on side on wire mesh in the vacuum chamber. Clean any ice or moisture out of moisture trap with a lint free cloth. Place lids on vacuum chamber and moisture trap and press START. CoreDry™ will cycle until drying is complete and chamber will pressurize so lids can be freely removed. If moisture is visible on core surface clean moisture trap and repeat drying process. Determine the final weight of the

dried specimens and use this weight as the dry mass A in the equation in Section 8.1.

12. CALCULATIONS

12.1 Calculate the bulk specific gravity as shown in Section 8.1.

12.2 Calculate percent relative compaction as follows:

$$\text{Percent Relative Compaction} = \frac{\text{Bulk Sp. Gravity}}{\text{Max. Sp. Gravity}} \text{ X } 100$$

NOTE 2: Max. Sp. Gr. information in CP 51.

12.3 Calculate the percent air voids as follows:

$$\text{Air Voids} = 100 - \text{Percent Relative Compaction}$$

12.4 Calculate the VMA as follows:

$$VMA = 100 - \frac{G_{mb}P_s}{G_{sb}}$$

Where:

VMA = Voids in mineral aggregate in percent of bulk volume,
G_{sb} = Bulk specific gravity of the aggregate,
G_{mb} = Bulk specific gravity of compacted mix,
P_s = Aggregate, percent by total weight of mix.

13. PRECISION

13.1 Duplicate specific gravity results by the same operator should not be considered suspect unless they differ more than 0.020.

14. RECORD

14.1 No CDOT Form, record on your own worksheet.

Exhibit 13

Commonwealth of Pennsylvania
Department of Transportation

PA Test Method No. **715LA**
Revised Feb. 2006
5 Pages

Method of Test for

DETERMINATION OF BULK SPECIFIC GRAVITY OF COMPACTED BITUMINOUS ROADWAY CORE SAMPLES

1. SCOPE

1.1 This method of test is intended for determining the bulk specific gravity of bituminous roadway core samples obtained for and governed under the Local Acceptance specification only.

2. TEST SPECIMEN

2.1 Core samples from the compacted pavement obtained in accordance with PaDOT methods of sampling a compacted roadway.

2.2 Specimen size – It is recommended, (1) that the diameter of the cored specimen be at least equal to four times the nominal maximum size of the aggregate; and (2) that the thickness of the core be the actual depth of the material as placed on the project or at least 1.5 times the nominal maximum aggregate size.

2.3 Specimens shall be free of foreign materials such as seal coat, tack coat foundation material, soil and any other material not a component of the original mix.

2.4 Sample Preparation

2.4.1 Specimens are to be separated from other pavement layers by sawing or other suitable means. Care shall be exercised to ensure separation does not damage the specimen.

2.4.2 Specimens shall be dried to a constant mass (constant mass shall be defined as the mass that is obtained when further drying does not alter the observed mass by more than 0.05 percent) using one of the procedures described:

(1) Dry the sample for at least 20 hours at 52 ± 3°C (125 ± 5°F), checking the dry weight at two hour intervals until constant mass is reached.

(2) Dry the sample in a large, flat pan of known mass in an oven at 110 ± 5°C (230 ± 9°F) until the fine aggregate-asphalt portion can be separated into pieces no larger than 6.4 mm (1/4 in.). Return the sample to the oven, checking the dry weight after cooling to room temperature [25 ± 5°C (77 ± 9°F)], every half hour until constant mass is attained on at least three consecutive weighings. Note: Caution should be exercised before using this method since the sample will be destroyed by this process. Samples coated with paraffin cannot be prepared by this method.

(3) Dry the sample by exposure to moving air of relatively low humidity while changing the orientation of the sample frequently and checking the dry weight every half hour until constant mass is attained on at least three consecutive weighings.

(4) Dry the sample in a vacuum drying apparatus meeting the requirements of, and in accordance with, ASTM D-7227-06.

2.5 Verification

2.5.1 Use methods 2.4.2(3) and 2.4.2(4) as preparation for acceptance testing only after verification in accordance with the appropriate specification.

VOLUMETER METHOD

3. APPARATUS

3.1 Weighing Device – Conforming to the requirements of AASHTO M-231, Class G2.

3.2 Thermostatically controlled water bath designed to maintain the bath temperature at 25 ± 0.5°C (77 ± 0.9°F)

3.3 Thermometer – ASTM 17C (17F), having a range of 19 to 27°C (66 to 80°F), graduated in 0.1°C (0.2°F) subdivivsions

3.4 Volumeter – Calibrated, 1.2L or an appropriate capacity depending on the sze of the sample.

4. PROCEDURE

4.1 Immerse the specimen in the water bath and saturate for at least 10 minutes. At the end of the 10 minute period, fill a calibrated volumeter with distilled water at 25 ± 1°C (77 ± 1.8°F). Place the saturated specimen into the volumeter and bring the temperature of the water in the volumeter to 25 ± 1°C (77 ± 1.8°F). Cover the volumeter making certain that some water escapes through the capillary bore of the lid. Wipe the volumeter dry and weigh the volumeter and contents to the nearest 0.1 gram.

4.2 Remove the sample from the volumeter, quickly damp dry the saturated specimen with a damp towel, and as quickly as possible weigh the specimen. Any water that seeps from the specimen during the weighing operation is considered a part of the saturated specimen. Dry the specimen to a constant mass (Sec. 2.4.2) and weigh to the nearest 0.1 gram.

Note: If desired, the sequence of testing operations can be changed to expedite the procedure by first determining the dry weight, then the weight of the saturated specimen in the volumeter and the mass of the saturated specimen.

5. CALCULATIONS

5.1 Calculate the dry basis bulk specific gravity (reported to three decimal places) as follows:

$$GSm = WSm / \{(0.997\ g/mL) \times [VVo - (1.003mL/g) \times (WT - WSa - WVo)]\}$$

GSm = bulk specific gravity at 25.0°C (77°F)
WSm = mass of the dry specimen (grams)
VVo = volume (mL) of the volumeter at 25.0°C (77°F) to the nearest tenth mL.
WT = total mass (gm) of the volumeter, saturated specimen, and water in the volumeter at 25.0°C (77°F).
WSa = Mass (gm) of the saturated specimen.
WVo = Mass (gm) of the volumeter.

5.2 Calculate the percent water absorbed (reported to one decimal place) as follows:

$$\% \text{ Abs.} = (WSa - WSm) / \{(0.997\ g/mL) \times [VVo - (1.003mL/g) \times (WT - WSa - WVo)]\} \times 100$$

If the percent water absorbed is greater than 3.0 percent, use the procedure for coating the specimen with melted paraffin and the calculations described in PTM 716.

SUSPENSION METHOD

6. APPARATUS

6.1 Weighing Device – Conforming to the requirements of AASHTO M-231, Class G2. The balance shall be equipped with a suitable suspension apparatus and holder to permit weighing the specimen while suspended from the center of the scale pan balance. The holder should be immersed to a depth sufficient to cover it and the sample during weighing. Wire suspending the holder shall be as small as practical to minimize any possible effects of a variable immersed length.

6.2 Water bath – for immersing the specimen in water while suspended under the balance, equipped with an overflow outlet for maintaining a constant water level and designed to maintain the bath temperature at 25 ± 1°C (77 ± 1.8°F).

7. PROCEDURE

7.1 Weigh the specimen in air to determine the dry mass after it has been dried to a constant mass and allowed to return to room temperature 25 ± 5°C (77 ± 9°F).

7.2 Suspend each specimen completely in water at 25 ± 1°C (77 ± 1.8°F) for 4 minutes and record the immersed mass. Remove the sample and quickly damp dry the saturated specimen with a damp towel, and as quickly as possible weigh the specimen and record the surface dry mass. Any water that seeps from the specimen during the weighing operation is considered a part of the saturated specimen.

Note: If desired, the sequence of testing operations can be changed to expedite the procedure by first determining the immersed mass, then the surface dry mass, and then the dry mass.

8. CALCULATION

8.1 Calculate the dry basis bulk specific gravity (reported to three decimal places) as follows:

$$GSm = WSm / (WSa - WSw)$$

GSm = bulk specific gravity
WSm = Dry mass (gm) of the specimen.
WSa = Mass (gm) of the surface dry specimen.
WSw = Immersed mass (gm) of the specimen.

8.2 Calculate the percent water absorbed (reported to one decimal place) as follows:

$$\% \text{ Abs.} = [(WSa - WSm) / (WSa - WSw)] \times 100$$

If the percent water absorbed is greater than 3.0 percent, use the procedure for coating the specimen with melted paraffin and the calculations described in PTM 716.